# Igiugig MHKDR Submission

## DATA COLLECTION

Water velocities were measured over a three month period in winter from November 5, 2016 to February 13, 2017 with an acoustic Doppler current profiler, theTeledyne RDI Workhorse 1200 kHz (ADCP). Concurrent measurements with a water column acoustic backscatter strength Shallow Water Ice Profiler (SWIP) by ASL Environmental Sciences identified periods when frazil ice was present in the water column. The sonars were deployed in approximately 5 m of water on the bed of the Kvichak River, adjacent to the Village of Igiugig, Alaska. Acoustic backscatter strength measurements with the SWIP spanned the entire ~150 day frazil ice season between November 2016 and April 2017.

Raw ADCP data were recorded as longitudinal ($u$) and latitudinal ($v$) velocities (*note:* these have not been rotated into streamwise and cross-stream components). Measured water velocities (V_meas) were then calculated from the horizontal magnitude with Equation 1,

$$V\_meas = \sqrt{v^2 + u^2} \qquad \textbf{Eq. 1}$$

## REGRESSION MODEL

Using a simple linear regression model to fit the data in MATLAB software (Mathworks 2022), water velocities were modeled as 20 year daily averages for one annual cycle; regression coefficients are shown in Figure 1. Measured velocities were filtered out from January 9-26, due to the presence of frazil ice on those dates in 2017. Please note that although the high value ($R^2$=0.9162) indicates a good fit to the model, these modeled velocities were derived from a regression model, and water speeds were not measured for 9 months of the year, indicated as missing data or NaNs (not a number) in the regression (Figure 1).

Raw data inputs to inform the modeling process include the 1) 3 months of water velocities measured by an ADCP, and 2) 20 year daily average discharge recorded over the period 1966-1987 at the USGS stream gage site in Igiugig (USGS 2016; Turnipseed and Sauer 2010). Full details of methodology are described in the final report (Kasper et al. 2017) included in this submission.

## DATA PROCESSING

The ADCP sonar was configured manually by sending commands via a terminal program. The commands were generated with PlanADCP v2.06 software (Teledye RDI 2022; Figure 2). The resulting ADCP raw files contain the water velocities and can be read with the WinADCP v1.14 software (Teledye RDI 2022) with the default output:

- Date
- Ensemble Number
- Range [m]
- Velocity Magnitude [mm/s]

The SWIP sonar was configured with the Ips5LinkE software v2.1.05 (ASL ES 2022; Figure 3). The backscatter values can be read with the same software (Ips5LinkE v2.1.05) with the output:

- Date
- Depth
- Backscatter [counts]
- Temperature [°C]

## FILE ORGANIZATION

The study plan and final report are included as .pdf files. There are two .zip files containing all of the raw binary data from both instruments and the processed data:

- Ice Study Plan.pdf
- UAF Kasper Frazil Ice Report_2017.pdf
- Raw Data.zip
- Modeled V Q.zip

RAW ADCP DATA

The raw water velocity data download from the instrument are shown as .000 files that can be read with the WinADCP v1.14 software (Teledye RDI 2022) with the default output:

- Date
- Ensemble Number
- Range [m]
- Velocity Magnitude [mm/s]

RAW SWIP DATA

The raw acoustic backscatter data download from the SWIP sonar are shown as *.001 files that can be read with configuration  software (Ips5LinkE v2.1.05) with the output:

- Date
- Depth
- Backscatter [counts]
- Temperature [°C]

MODELED VELOCITY

The processed data is included as a .csv file with a .pdf figure file, showing the regression model used to calculate the 20 year daily average velocities. Missing data are represented as NaNs (Figure 1). The .csv file has 2 header lines defining variables and units:

- day_of_year = text string indicating day of the year*
- Q_avg = 20 year daily average discharge ($m^3/s$) from 1967-1987 calculated by USGS (2016)
- V_meas = 3 months of measured ADCP horizontal velocity (m/s) from Nov 2016 - Feb 2017
- V = 20 year daily average modeled velocity (m/s)

*Note that this time period represents a leap year; there are 29 days in February.

# REFERENCES


1) Kasper, J. L., P. Duvoy and N. Konefal (2017) Kvichak River Frazil Ice Study Final Report, September 2017, Fairbanks, AK. 58 pp.

2) U.S. Geological Survey (2016) National Water Information System data (Water Data for the Nation), Site no. 15300500 Kvichak River at Igiugig, accessed online 12/5/22 https://waterdata.usgs.gov/nwis/inventory/?site_no=15300500

3) Turnipseed, D.P. and V.B. Sauer (2010) Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p. accessed online 11/22/22 http://pubs.usgs.gov/tm/tm3-a8/


# LINKS TO SOFTWARE

ASL Environmental Sciences (2022), SWIP Shallow Water Ice Profiler, accessed online 12/5/2022 https://aslenv.com/swip.html

Mathworks (2022) Linear Regression. Mathworks Help Center accessed online 12/5/22 https://www.mathworks.com/help/matlab/data_analysis/linear-regression.html

Teledyne RD Instruments (2022) Software Portal, accessed online 12/5/2022 http://www.teledynemarine.com/rdi/support

# FILENAMES and FILE DESCRIPTIONS

**Ice Study Plan.pdf**
System requirements analysis to inform ice study design, study plan and equipment, and deployment plan for over winter data collection

**UAF Kasper Frazil Ice Report_2017.pdf**
Report on overwinter in water ice study in the Kvichak River, Igiugig.

**Kvichak River Ice Monitoring - Raw Data.zip**
Raw data sets for 2017 ice monitoring for Kvichak River. Includes ADCP data files and SWIP data file

**Kvichak River Ice Monitoring - Modeled V Q.zip**
Processed dataset including: 20 year daily average modeled velocity and discharge from 1967-1987, measured velocity from Nov 2016 - Feb 2017, and a figure showing the regression model.